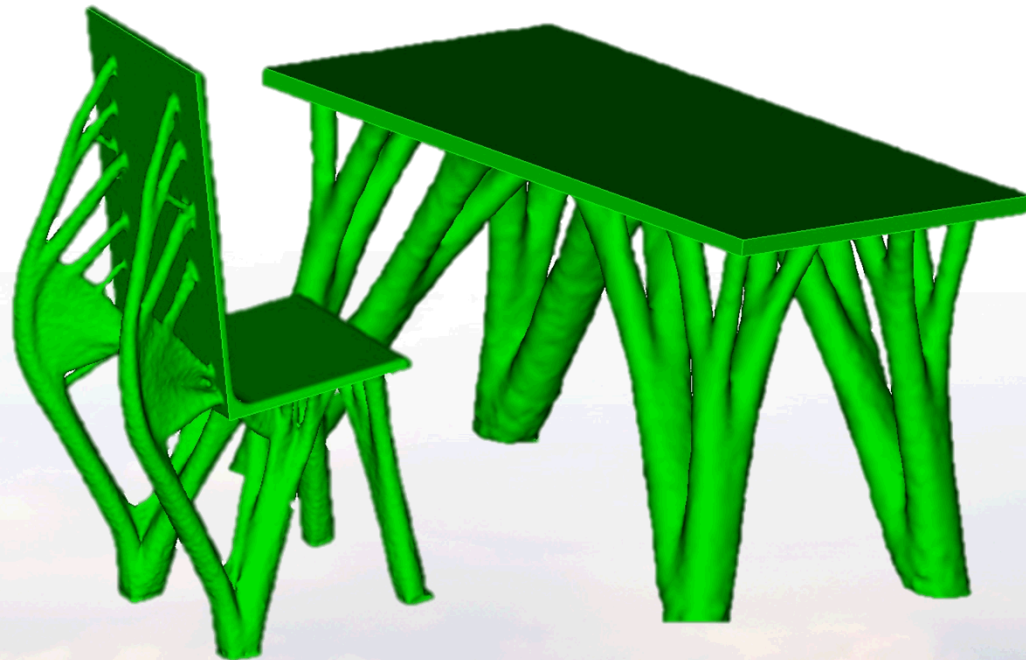


# Function-based Design Enabled by AM

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*Simulation Modeling  
Sciences Department*  
**15 June 2015**



## Contributors:

Miguel Aguilo  
Joshua Robbins  
Tom Voth



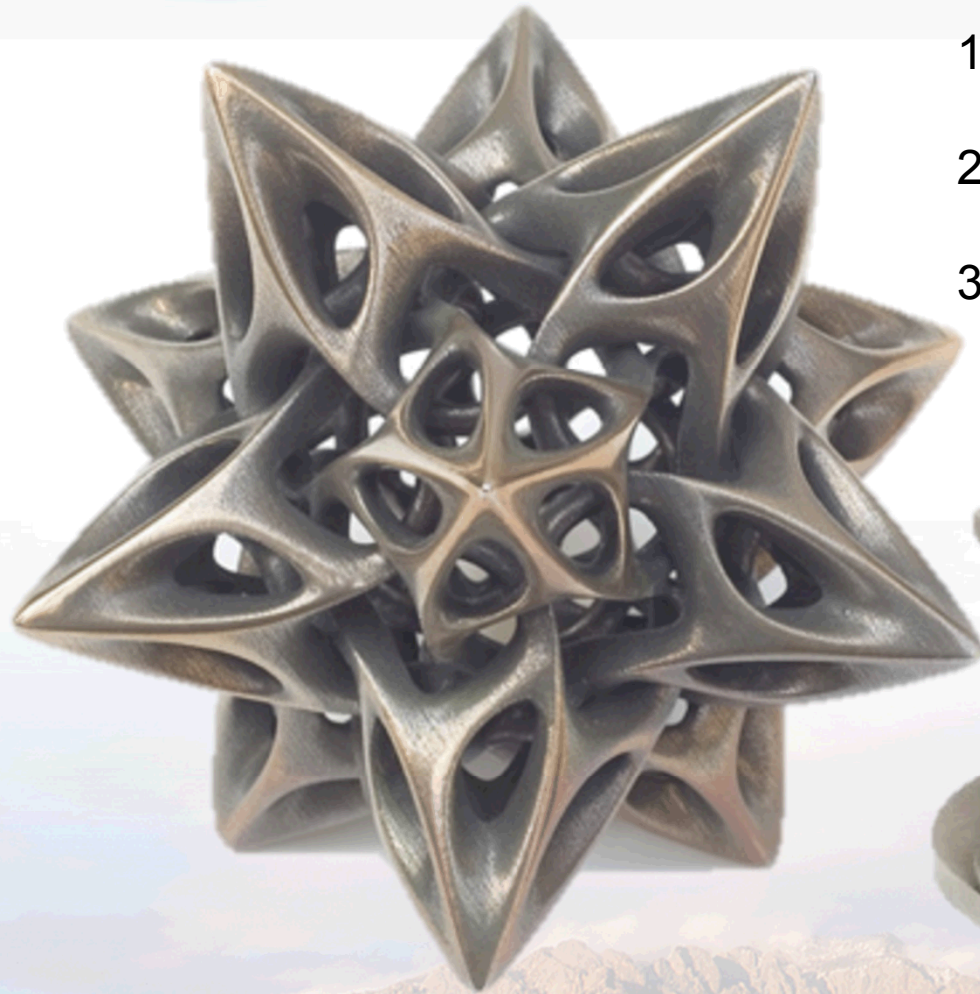
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# Objectives



1. Exploit expanded design space made possible with AM
2. Enable function-based design (impacting design with analysis)
3. Make Topology Optimization easy-to-use



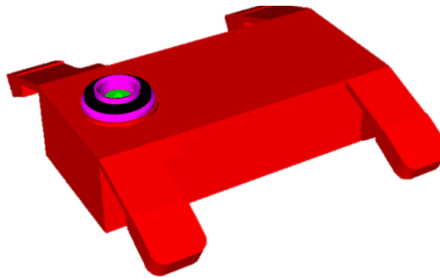
# Form vs. Function

CURRENT

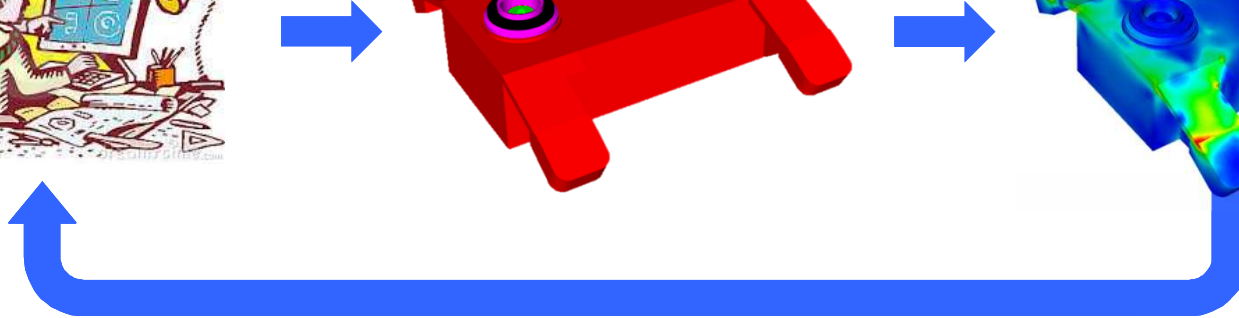
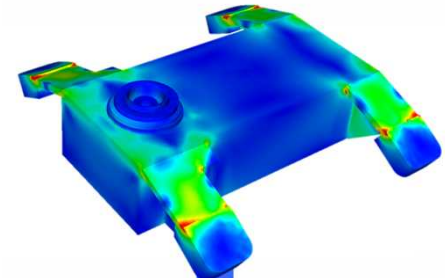
Specify Form



Design



Verify Function Using FEA

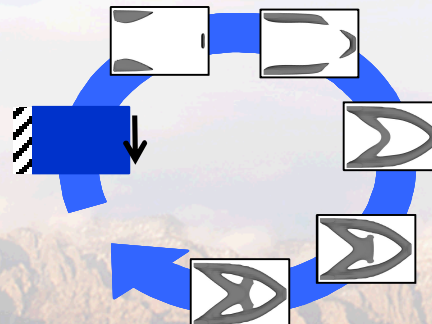


NEW

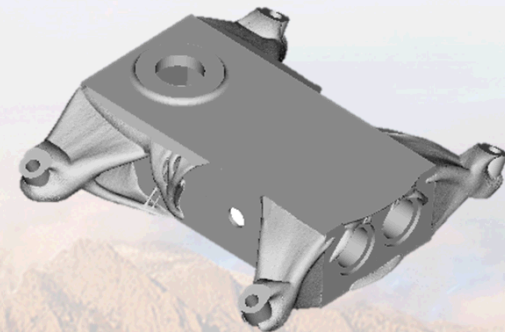
Specify Design Domain and Function



Use Topology Optimization (FEA) to Determine Form that Meets Function



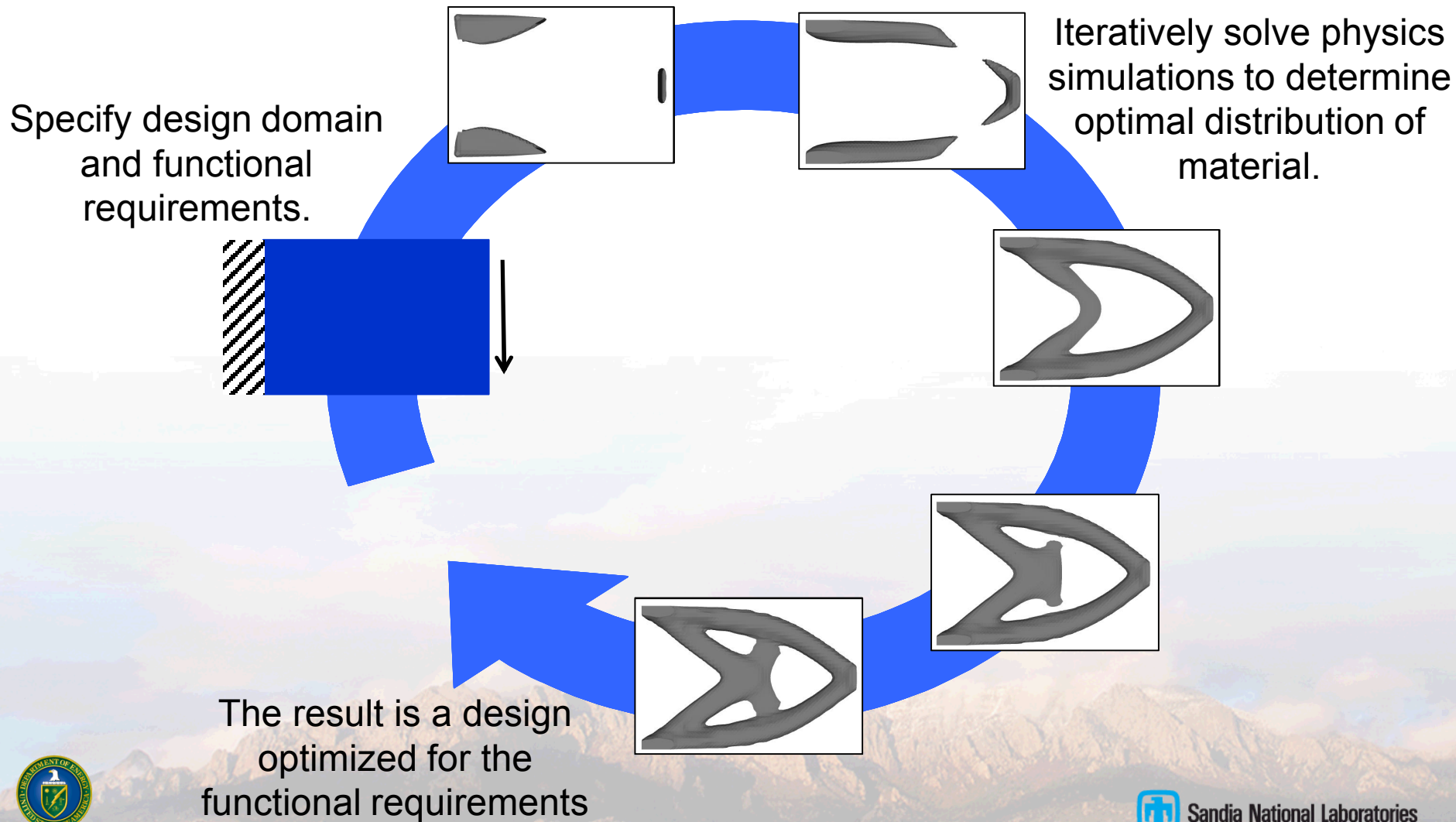
Optimized Design (Form)

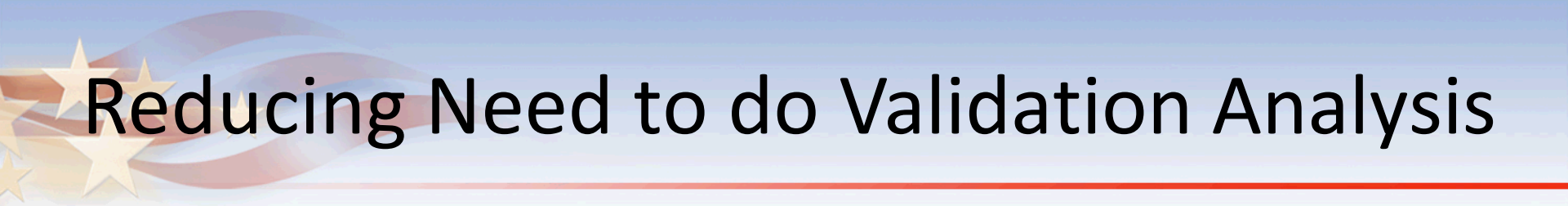




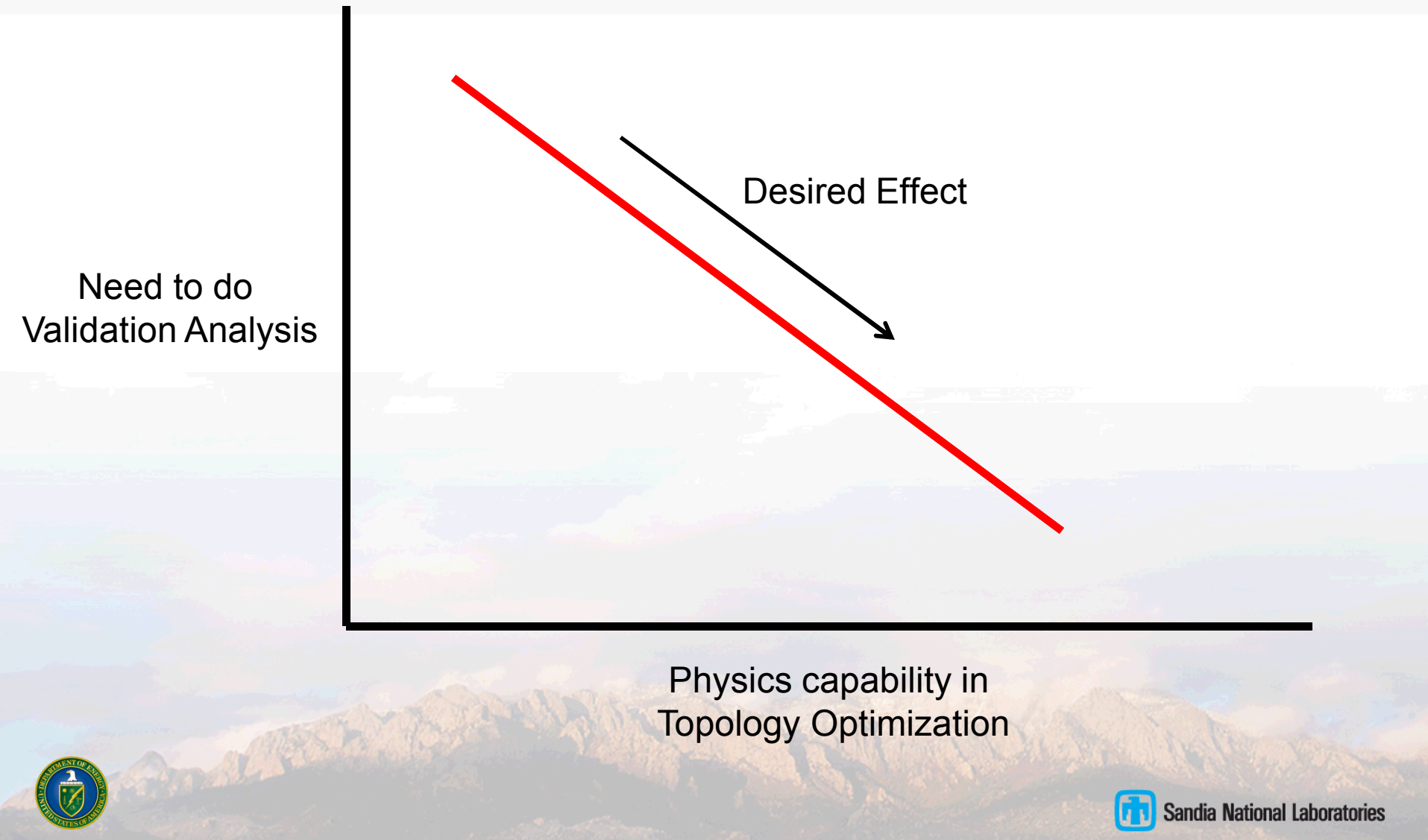


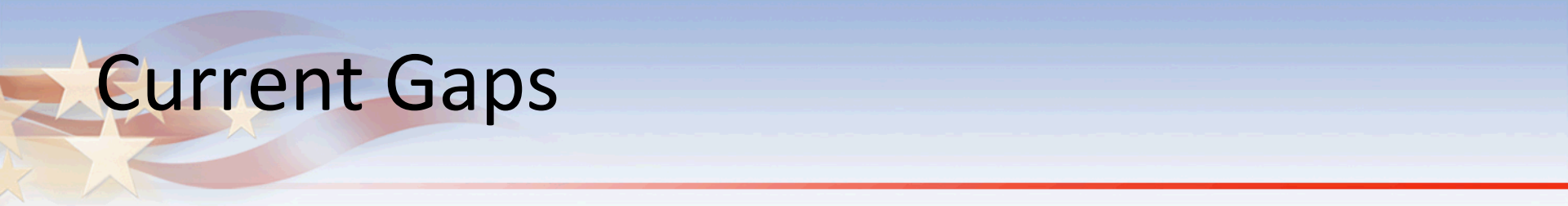
# Topology Optimization





# Reducing Need to do Validation Analysis





# Current Gaps

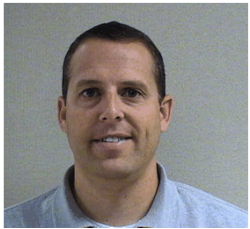
- Topology Optimization is hard to use—requires too much expertise.
- Realistic design problems require lots of computing power
- Limited physics capabilities
- Very non-interactive



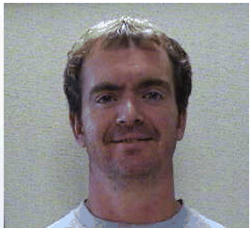
# Topology Optimization Team at Sandia



Miguel Aguilo (1542) Implementing topology optimization in Sierra physics



Brett Clark (1543) Implementing topology optimization-based design environment in Sandia Analysis Workbench (SAW)



Josh Robbins (1444) Implementing topology optimization in Albany and Sierra physics



Tom Voth (1443) Implementing topology optimization in Albany and Sierra physics



**Early Application/Design Collaborators:** Nick Leathe (2616), Bradley Jared (1832), Luke Duffield (2997), Ted Winrow (2617), Brandon Moore (2241)



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# Current Capabilities

## Albany research platform

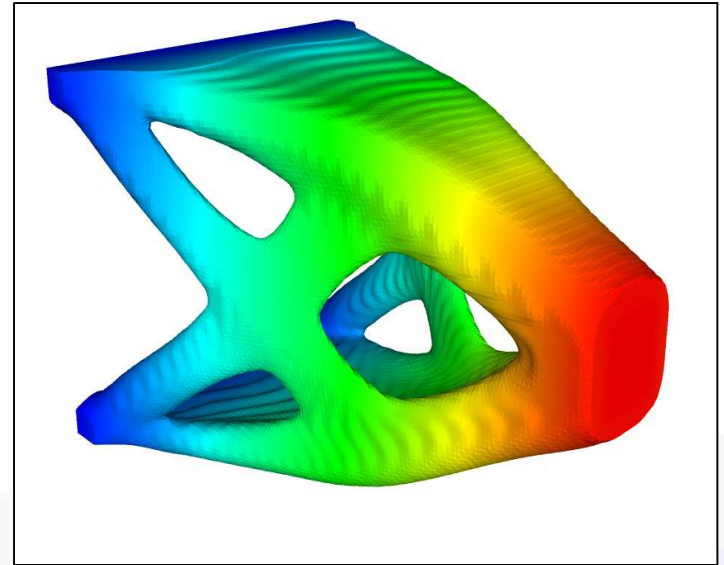
- Linear Statics
- Thermal
- Multi-physics
- Multi-load scenarios

## Sierra production platform

- Linear Statics coming on line

## Design Environment (leveraging Albany)

- Problem setup
- Job Submission on HPC platforms
- Continuous visual feedback of evolving design
- Post-processing (smoothing, export)







# Demo



# Future Directions

## Albany research platform

- Prototyping
  - Optimization restart
  - Guided optimization

## Sierra production platform

- Thermal
- Multi-physics, multi-load, multi-constraint
- XFEM (for modal and implicit boundaries)
- Sierra SM (solid mechanics)

## Design Environment

- Support for Sierra
- Guided optimization
- Mesh refinement strategies for optimizing performance
- Expanded design editing/post processing

